इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 8004 (1976): Recommended procedure for welding of rigid PVC [MTD 12: Welding Applications]

"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

IS : 8004 - 1976
(Reaffirmed 2003)

Indian Standard

RECOMMENDED PROCEDURE FOR WELDING OF RIGID PVC (RIGID POLYVINYL CHLORIDE)

UDC 621·791·58 : 678·743·22·077

© *Copyright* 1976

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

[redacted] Gr 4

May 1976

Indian Standard

RECOMMENDED PROCEDURE FOR WELDING OF RIGID PVC (RIGID POLYVINYL CHLORIDE)

Welding General Sectional Committee, SMDC 14

Chairman	*Representing*
SHRI S. V. NADKARNI	Advani Oerlikon Limited, Bombay
Members	
SHRI P. S. VISVANATH (*Alternate* to Shri S. V. Nadkarni)	
SHRI J. K. AHLUWALIA	Stewarts and Lloyds of India Ltd, Calcutta
SHRI V. N. DESAI (*Alternate*)	
SHRI S. BALASUBRAHMANYAM	Binny Ltd, Madras
SHRI K. BALMANOHAR	Hindustan Shipyard Ltd, Visakhapatnam
SHRI B. C. BISWAS	National Test House, Calcutta
SHRI R. N. CHAKRABORTY	Braithwaite and Co (India) Ltd, Calcutta
DIRECTOR, RESEARCH, AND DESIGN (B & R BRANCH)	Public Works Department, Government of Haryana, Chandigarh
EXECUTIVE ENGINEER (ELECTRICAL), ELECTRICAL DIVISION No. 1, NEW DELHI	Central Public Works Department, New Delhi
EXECUTIVE ENGINEER (ELECTRICAL), CENTRAL ELECTRICAL DIVISION No. 1, CALCUTTA (*Alternate*)	
SHRI H. D. GOVINDARAJ	Philips India Ltd, Bombay
DR J. VAID (*Alternate*)	
DR G. J. GURURAJA	Central Mechanical Engineering Research Institute (CSIR), Durgapur
SHRI S. K. HARI	Malik Electricals Private Ltd, Bombay
SHRI M. K. SINHA (*Alternate*)	
DR J. JAIN	Tata Engineering and Locomotive Co Ltd, Jamshedpur
PROF A. P. JAMBULINGAM	Indian Society for Technical Education, New Delhi

(*Continued on page* 2)

© *Copyright* 1976

INDIAN STANDARDS INSTITUTION

This publication is protected under the *Indian Copyright Act* (XIV of 1957) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

(*Continued from page* 1)

Members	*Representing*
Joint Director (M & C), RDSO, Lucknow	Ministry of Railways
Chemist and Metallurgist, Integral Coach Factory, Perambur (*Alternate* I)	
Production Engineer (Shell), Integral Coach Factory, Perambur (*Alternate* II)	
Shri M. T. Kanse	Directorate General of Supplies and Disposals (Inspection Wing)
Shri S. N. Basu (*Alternate*)	
Shri G. S. Kodikal	Bharat Heavy Plate and Vessels Ltd, Visakhapatnam
Shri A. P. Sanyal (*Alternate*)	
Dr K. V. Krishnamurthy	Research and Development Organization (HSL), Ranchi
Dr K. V. Subba Rao (*Alternate*)	
Shri N. Mukherjee	Indian Oxygen Ltd, Calcutta
Shri R. Purkayastha (*Alternate*)	
Shri A. C. Mukherjee	Apar Private Ltd, Bombay
Lt-Col P. R. Narasimhan	Engineer-in-Chiefs' Branch, Army Headquarters
Shri K. S. Hans (*Alternate*)	
Shri M. M. Patel	Association of Indian Engineering Industry, Calcutta
Shri R. M. Kapadia (*Alternate*)	
Shri K. M. Pole	Walchandnagar Industries, Walchandnagar
Shri G. D. Apte (*Alternate*)	
Shri H. L. Prabhakar	Larsen & Toubro Ltd, Bombay; *and* Chemical Plant and Machinery Association of India, Bombay
Shri P. B. Rao	Ministry of Defence (DGI)
Shri S. Gangopadhyay (*Alternate*)	
Shri V. S. G. Rao	Department of Atomic Energy, Bombay
Shri L. M. Tolani (*Alternate*)	
Representative	National Metallurgical Laboratory (CSIR), Jamshedpur
Shri S. C. Roy	Central Boilers Board, New Delhi
Shri V. V. Sathyanarayana	Mining & Allied Machinery Corporation Ltd, Durgapur
Shri S. K. Banerjia (*Alternate*)	
Shri S. K. Sengupta	Hindustan Steel Ltd, Ranchi
Shri V. V. Kaviswar (*Alternate*)	
Shri N. K. Sethi	Bharat Heavy Electricals Ltd, Hardwar
Shri H. K. Sharma	Directorate General of Technical Development, New Delhi
Shri K. C. Sharma (*Alternate*)	
Shri A. Srinivasulu	Bharat Heavy Electricals Ltd, Tiruchirapalli
Shri B. Pattabhiraman (*Alternate*)	
Shri S. Sundaresan	Directorate General of Employment & Training, New Delhi

(*Continued on page* 14)

Indian Standard

RECOMMENDED PROCEDURE FOR WELDING OF RIGID PVC (RIGID POLYVINYL CHLORIDE)

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 19 February 1976, after the draft finalized by the Welding General Sectional Committee has been approved by the Structural and Metals Division Council.

0.2 In recent years considerable progress has been made in the application of welding in the plastic industry. This standard has been prepared as a guide to the industry in welding rigid PVC.

0.3 In the preparation of this standard assistance has been derived from DIN 16930 'Welding of Rigid PVC (Rigid Polyvinyl Chloride) -Directions' issued by Deutscher Normenausschuss, Berlin.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard recommends provisions for welding rigid PVC (rigid polyvinyl chloride).

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 5687-1970† shall apply.

3. GENERAL

3.1 Rigid PVC is welded in a paste-like condition. The factors influencing the weldability of rigid PVC are the welding temperature, duration of the heat application and the welding pressure.

---

*Rules for rounding off numerical values (*revised*).

†Glossary of terms relating to welding of plastics.

3.2 With the various welding processes specified in this standard the welding temperature of rigid PVC lies between 180 and 210°C. Temperatures above 210°C should be avoided because of possible decomposition of the rigid PVC. Welding temperatures below 180°C result in defective welds.

4. HOT GAS WELDING

4.1 In this process the connecting parts to be welded and the filler material are heated by suitable hot gases (referred to as welding gas hereafter) to the necessary welding temperature and welded under pressure. Oxygen and combustible gases should not be normally used for safety reasons. Caution is also advisable even with non-combustible gases like nitrogen and carbon dioxide.

4.2 **Welding Apparatus** — Manual welding torches are normally used in which gas free from oil and moisture and supplied at a pressure of 0·05 MPa (0·5 kgf/cm^2) is heated to the required temperature. Examples of welding apparatus normally used are given in Fig. 1 and 2. In practice air is chiefly used as welding gas for rigid PVC. The temperature of the welding gas should be adjustable. It is measured at 5 mm from the end of the filler rods.

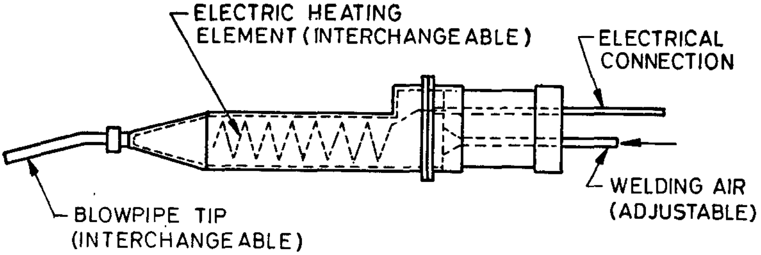

ELECTRIC HEATING ELEMENT (INTERCHANGEABLE)
ELECTRICAL CONNECTION
WELDING AIR (ADJUSTABLE)
BLOWPIPE TIP (INTERCHANGEABLE)

FIG. 1 ELECTRICALLY-HEATED HOT AIR WELDING EQUIPMENT

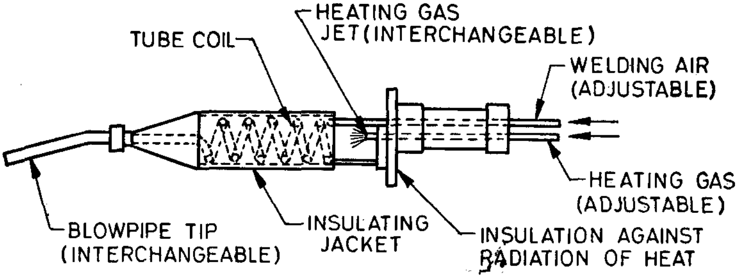
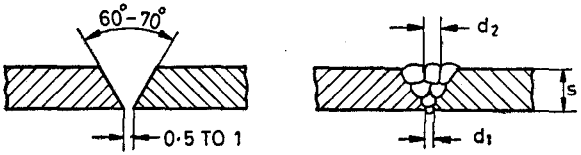

HEATING GAS JET (INTERCHANGEABLE)
TUBE COIL
WELDING AIR (ADJUSTABLE)
HEATING GAS (ADJUSTABLE)
BLOWPIPE TIP (INTERCHANGEABLE)
INSULATING JACKET
INSULATION AGAINST RADIATION OF HEAT

FIG. 2 GAS-HEATED HOT AIR WELDING EQUIPMENT

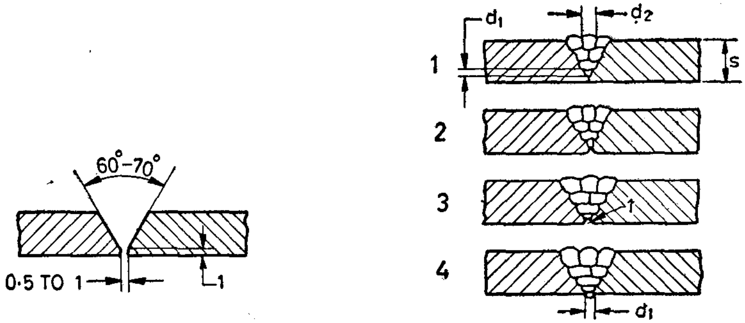
4.3 Filler Material — The filler materials normally used are rigid PVC rods or PVC rods containing plasticizers. Sizes of rods normally used are 2, 3 or 4 mm. 2 mm rods are used for root and sealing runs (d_1 in Fig. 3 to 8). For depositing the middle portion and finishing runs of the weld 3 mm rods are used when the thickness to be welded is up to and equal to 4 mm (d_2 in Fig. 3 to 8). 4 mm rods are used when the thickness to be welded exceeds 4 mm.

4.3.1 In special cases (for example, when lining surfaces with rigid PVC films) strips (filler strips) of rigid PVC are also used with thickness 0·8 to 1 mm and width up to 15 mm.



All dimensions in millimetres.

FIG. 3 SINGLE-BUTT WELD WITHOUT SEALING RUN

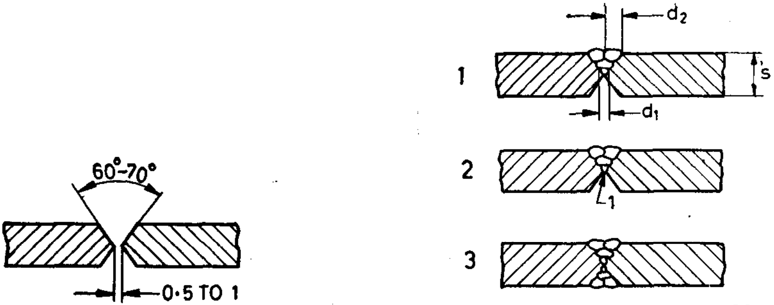


1. Welding V-weld
2. Make an angled root
3. Make the root round
4. Weld the sealing run

4A PREPARATION OF THE V-BUTT WELD 4B WELDING THE V-BUTT WELD

All dimensions in millimetres.

FIG. 4 V-BUTT WELD WITH SEALING RUN



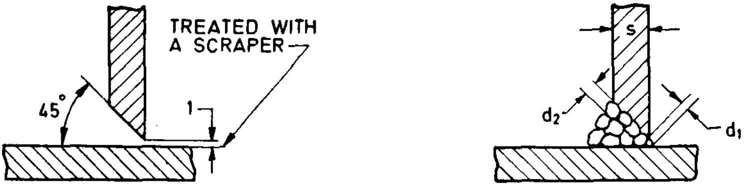
1. Weld one side of the double V-butt weld
2. Make the root round
3. Weld the other side of the V-butt weld

5A PREPARATION OF THE DOUBLE V-BUTT WELD

5B WELDING THE DOUBLE V-BUTT WELD

All dimensions in millimetres.

FIG. 5 DOUBLE V-BUTT WELD

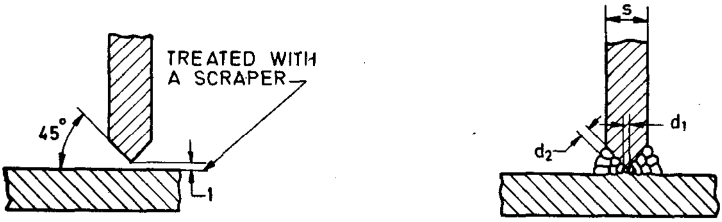


6A PREPARATION OF THE FILLET WELD

6B WELDING THE FILLET WELD

All dimensions in millimetres.

FIG. 6 T-JOINT WITH SINGLE FILLET WELD

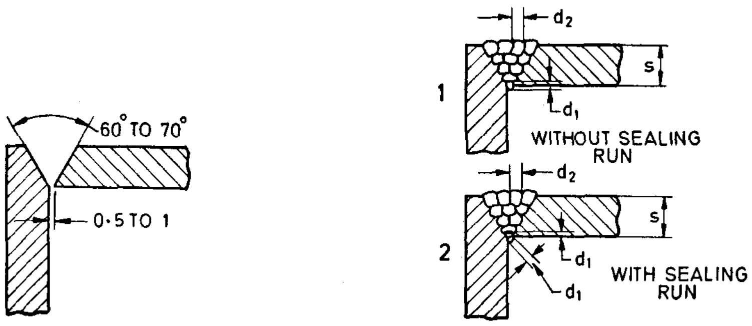


7A PREPARATION OF THE FILLET WELD

7B WELDING THE FILLET WELD

All dimensions in millimetres.

FIG. 7 T-JOINT WITH DOUBLE FILLET WELD



1. Without sealing run
2. With sealing run

8A PREPARATION OF THE BUTT WELD 8B WELDING THE BUTT WELD

All dimensions in millimetres.

Fig. 8 Corner Joint With Single V-Butt Weld

4.4 Forms of weld — Butt welds are normally made as single-V without sealing runs (*see* Fig. 3), single-V with a sealing run (*see* Fig. 4) or as double-V butt welds (*see* Fig. 5). T-joints and corner joints (*see* Fig. 6, 7 and 8) should be avoided wherever possible. In place of T-joints it is preferable to use joint shown in Fig. 9 with single- or double-V butt weld.

4.5 Preparation of the Parts to be Welded — The surfaces of the parts to be welded (*see* Fig. 3 to 8) are prepared by planing, scraping, filing, rasping, milling or grinding, or if they are not chamfered as shown in Fig. 6A and 7A treated with a scraper.

4.5.1 The surfaces to be welded and the filler rod should be free from shavings, traces of grease and other impurities. Cleaning agents which have a softening or swelling effect on rigid PVC should not be used.

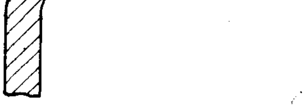


Fig. 9 Better Solution Than the Corner Joint Shown in Fig. 8

4.6 Welding Procedure — Wherever possible welding should be carried out in flat position. The filler rod is sharpened to an angle of 30°, fastened to the weld line and continuously introduced to the weld joint by hand under constant uniform heating of the weld with the torch and with even and almost vertical pressure (*see* Table 1 for the recommended pressure). At the same time a slight pendulum movement should be made with the nozzle of the welding torch between the base material and filler rod at an interval of 5 mm from the weld (*see* Fig. 10).

TABLE 1 RECOMMENDED PRESSURE ON FILLER ROD

Filler Rod Size	Recommended Pressure
mm	kN (kg)
2	10 (1 000)
3	20 (2 000)
4	30 (3 000)

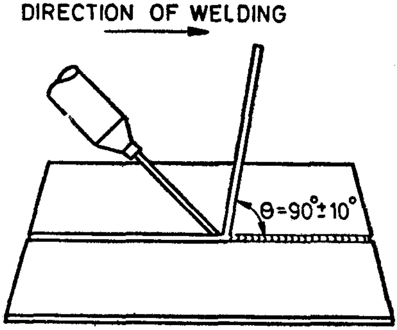


Fig. 10 Right: The Filler Rod is Held Almost Vertical

4.6.1 The filler rod should not be held at an oblique angle because this can cause tension in the weld seam which impairs its quality and results in cracks (*see* Fig. 11).

4.6.2 In order to obtain a welding temperature of 180-210°C the welding gas should have a temperature of at least 300°C (*see* **3.2**) measured at a point 5 mm from the nozzle of the welding torch.

4.6.3 If welding is satisfactory a bow-wave is formed at the filler rod in front of the weld. Over-heating and decomposition of the base material, filler rod and weld seam are apparent in their black colour. Decomposed portions of this kind should be removed and re-welded.

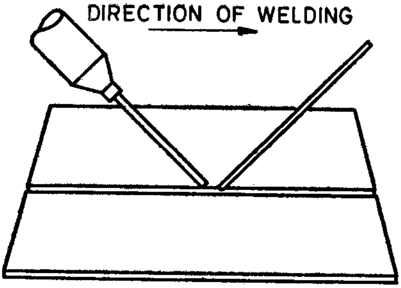


Fig. 11 Wrong: If the Filler Rod is Held Obliquely. This Subjects the Welds to Tension and Causes Stress

4.6.4 The spatter (flash) resulting during welding between the filler rod and base material, and between the filler rod and the weld joint already made shall be removed before depositing further weld material since the spatter material get overheated and decompose during subsequent welding.

4.6.5 Excessive reinforcements proud of the normal weld surface should be avoided as they increase the notch effect and result in failure of the welded joint if they are subjected to continuous stress.

4.7 Finishing the Weld Joint — Normally completed welds are not machined. When the welds are to be machined machining marks should be avoided as they result in cracks when the joint is subjected to continuous stress.

4.8 Quality of the Welds — The following factors influence the quality of the welded joint:

a) Choice of correct welding conditions (temperature, speed and pressure);
b) Form of weld;
c) Number of runs in the welded joint — a few thick runs give better results than a number of thin ones;
d) Appearance of machining marks;
e) Cleanliness of filler material and the surfaces to be welded; and
f) Skill of the welder.

4.8.1 In general a welded joint can be considered to be a good joint if its strength is at least equal to 0·6 times the strength of the base material.

5. HEATED TOOL WELDING

5.1 Welding Process — In this process the surfaces of the parts to be welded are heated to the required temperature by suitably designed heating tools and welded under pressure usually without filler material.

5.2 Welding Apparatus — The heating tools used for welding are heated electrically, with gas or by other means. They transmit their heat by conduction to the connecting surfaces of the parts to be welded. Care should be taken that scale is not formed on heated tools. Residues of PVC should be prevented from adhering. This can be achieved effectively by means of a polytetrafluore ethylene covering.

5.3 Filler material is not generally used.

5.4 Weld Forms — Pressure butt weld (*see* Fig. 12) or lap joints with lap weld are the normally used weld forms in heated tool welding process.

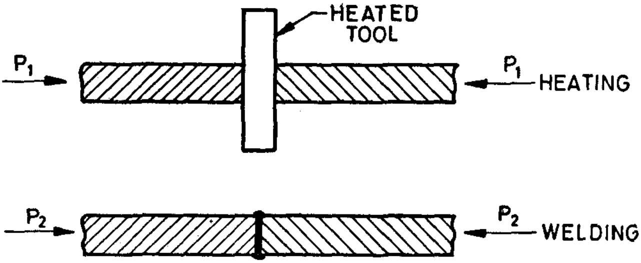


FIG. 12 HEATED TOOL WELDING

5.5 Preparation of the Parts to be Welded — Where necessary the connecting surfaces to be welded are faced. The surfaces and the heated tool should be free from shavings, traces of grease and other impurities. Cleaning agents which have a softening or swelling effect on rigid PVC should not be used.

5.6 Welding Procedure — The surfaces to be welded are pressed against the heating tool in a suitable device. As soon as the welding temperature is reached the heating tool is removed and the connecting surfaces are welded together under pressure in the device (*see* Fig. 12).

5.7 Weld spatter (flash) shall be removed as far as possible from the weld.

6. IMPULSE WELDING

6.1 Welding Process — In this process the surfaces of the parts to be welded are brought in contact with each other, heated by heat impulses from suitable heating tools and welded under pressure.

6.2 Welding Apparatus — The impulse welding apparatus consists of a power source, pressure device and impulse pressure plate. The impulse pressure plate has electrical resistance elements of extremely low heat capacity which are electrically heated briefly (for example, 0·25 second).

6.3 Filler Material — Filler material is not generally used.

6.4 Weld Forms — Lap joints with lap welds are normally used in impulse welding process.

6.5 Preparation of Parts to be Welded — The joining surfaces of the parts to be welded require no special preparation. The surface and the heating apparatus should , however, be free from traces of grease and other impurities. Cleaning agents which have a softening or swelling effect on rigid PVC should not be used.

6.6 Welding Procedure — The connecting surfaces are placed on a mounting plate covered with an elastic heat insulator so that they overlap. The impulse pressure plate (plate with heating element and heat insulator) is pressed on to the welding line by means of a suitable pressure device and heated electrically for a brief period. The pressure is maintained until the welding zone has cooled off. In the case of thicknesses 0·06 to 0·2 mm the mounting plate is also designed as an impulse pressure plate. The weld seams need no finishing.

6.7 Quality of Weld — The provisions contained in **4.8** shall apply.

7. FRICTION WELDING

7.1 Welding Process — In friction welding the joining surface of the parts to be welded — usually solids of revolution — are heated to the required temperature by frictional heat and welded under pressure without filler material.

7.2 Welding Apparatus — The friction welding apparatus consists of devices (for example, a turning machine) which permit the connecting surfaces of the parts to be welded to turn sufficiently under pressure against each other so that the surfaces are heated to the welding temperature by friction.

7.3 Filler Material — Filler material is not generally used.

7.4 Weld Forms — Butt joints with welded contact surfaces are produced by friction welding.

7.5 Preparation of Parts to be Welded — In the case of parts up to 40 mm diameter the welding surfaces shall be faced. When the diameter of the parts exceeds 40 mm, one or both of the connecting surfaces shall be perpared so that they taper to a cone with a slope of $\alpha/2$ satisfying the condition

$$\tan \frac{\alpha}{2} = \frac{D}{2}$$

where D is the diameter of the part to be tapered.

7.5.1 The joining surfaces shall be free from shavings, traces of grease and other impurities. Cleaning agents having a softening or swelling effect on rigid PVC should not be used.

7.6 Welding Procedure — The parts to be welded are clamped in the turning device and turned against each other (*see* Fig. 13) under pressure. After the surfaces reach the welding temperature — which is apparent when pasty material oozes allround the circumference — axial pressure is gradually increased. The attachment is then unclamped and the movement of both parts against each other is concluded. The welding pressure is maintained until the weld joint is cooled off.

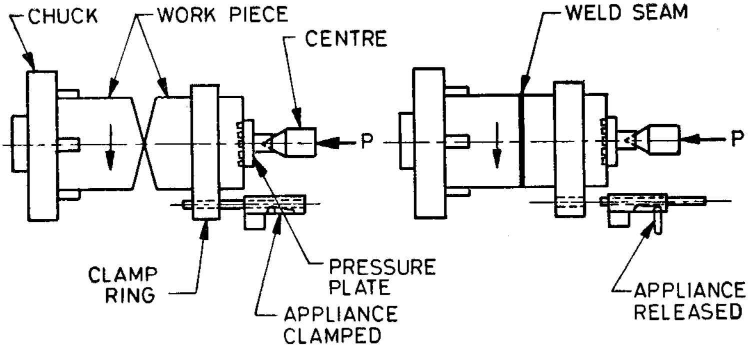


FIG. 13 FRICTION WELDING

7.6.1 The joint shall be finished according to **4.7**.

7.7 Quality of Welded Joint — The strength of the welded joint approaches that of the base material.

8. HIGH-FREQUENCY WELDING

8.1 Welding Process — The joining surfaces of the part to be welded are heated to the required welding temperature in a condenser field of a high-frequency current source and welded under pressure usually without filler material.

8.2 Welding Apparatus — High frequency welding equipment consists of a high frequency generator, welding press and electrode (welding tool) adapted to the weld form.

8.3 Filler Material — In the case of high frequency welding filler material is not generally used.

8.4 Weld Form — Lap joints with lap welds are obtained in HF-welding.

8.5 Preparation of Welding Faces — The joining faces of the parts (usually films) to be welded do not normally require any special preparation. The surfaces should, however, be free from impurities. Cleaning agents having a softening or swelling effect on rigid PVC shall not be used.

8.6 Welding Procedure — The parts to be welded are placed on the mounting plate so that they overlap. They are heated and welded by HF energy after applying pressure on the work piece. The HF energy supply is regulated according to the thickness of the film or sheet. After switching off the HF energy supply, the pressure is maintained until the weld zone is cooled off and has regained its dimensional stability.

8.7 Finishing the Welded Joint — The provision contained in **4.7** shall apply.

(*Continued from page* 2)

Members	*Representing*
Superintending Engineer, Central Mechanical Circle, Madras	Public Works Department, Government of Tamil Nadu, Madras
Shri S. G. N. Swamy	Mukand Iron & Steel Works Ltd, Bombay
Shri R. K. Srivastava (*Alternate*)	
Shri C. R. Rama Rao, Director (Struc & Met)	Director General, ISI (*Ex-officio Member*)

Secretary

Shri M. S. Nagaraj
Deputy Director (Struc & Met), ISI

Subcommittee for Welding and Cutting Processes and Procedures, SMDC 14 : 3

Convener	
Shri H. L. Prabhakar	Larsen & Toubro Ltd, Bombay
Members	
Assistant Director (Welding), RDSO, Lucknow	Ministry of Railways
Shri Awtar Singh	Bears Project, Talwara Township, Dist Hoshiarpur (Punjab)
Shri S. P. Dasgupta	Central Mechanical Engineering Research Institute (CSIR), Durgapur
Shri V. G. Jagannath	Bharat Heavy Electricals Ltd, Tiruchirapalli
Shri R. Visvanathan (*Alternate*)	
Shri M. T. Kanse	Directorate General of Supplies and Disposals (Inspection Wing)
Shri S. N. Basu (*Alternate*)	
Shri G. S. Kodikal	Bharat Heavy Plate and Vessels Ltd, Visakhapatnam
Shri A. P. Sanyal (*Alternate*)	
Shri J. C. Magoo	Bharat Heavy Electricals Ltd, Hardwar
Shri A. C. Mukherjee	Apar Private Ltd, Bombay
Shri S. V. Nadkarni	Advani Oerlikon Limited, Bombay
Shri B. Malkani (*Alternate*)	
Shri J. R. Prasher	Engineers India Ltd, New Delhi
Shri M. R. C. Nagarajan (*Alternate*)	
Shri R. Purkayastha	Indian Oxygen Ltd, Calcutta
Shri S. K. Burman (*Alternate*)	
Shri S. L. Venkataraman	The K. C. P. Ltd, Madras
Shri J. R. D. Saxton	Lloyds Register of Shipping, Calcutta
Shri J. N. Goswamy (*Alternate*)	